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To: **Katie Hafner, Newsweek Magazine**

Fax #: 1-512-476-1966 **Date** Sunday, September 17, 1995

From: Roland F. Bryan **No. Of Pages** **11**

Dear Katie,

Sorry for so many pages but . . .

The first few were written at the time of the event in Boston and contain some answers to questions posed in anticipation of the meeting.

The second item is a copy of the write-up on the "anatomy" scroll that you have pinned to your wall (thank you for the comment). I send this because I am not sure if you have this brief description (you should know that there is also a full calendar-poster from which that was taken. I still have a couple if you would like one).

The last is a whitepaper on building an Internet Storefront. This is some contemporary information on a direction that at least some people are pursuing.

I have an extra copy of the preview article on the Culler event if you would like it sent to you? You can call me at (805) 963-8801.

Roland

THE BEGINNING OF THE INTERNET

(Roland F. Bryan - 20 August 1994)

Success Through Dedication

In 1969, the catalyst and leadership for the creation of the new approach toward interconnection of computer systems that was called packet switching came from ARPA, which clearly defined a vision and set the goals to meet it.

I personally believe that the intense interest shown by ARPA, along with the drive and the style of "directed funding" used by Larry Roberts and others from ARPA, were as important to success of the ARPANET as any factor, scientific or otherwise.

Another factor were the Principal Investigators who had spent the 60s creating new computer science and who could see they would now be able to share results directly with their peers. No one wanted to be left out so everyone tried to be involved.

That mixture of researchers and students made it all come together very rapidly because they were caught up in a collective dynamic. The goals were clear and challenging and the reward was the excitement of doing something where one's individual contribution would be felt, recognized, and understood.

The Importance of ARPA and Government Sponsored Research

In the thirty years spanning the 50s, 60s and 70s, three important forces changed and benefited our country; two of them sponsored and funded by the government and the third the result of individual citizens participating in the free enterprise system. The timing of those forces could not have been better.

At the end of WWII the U.S. government promoted, and heavily funded, basic computer science research at institutions all over the country and did so for several decades. Contracts and Grants to universities came from the National Institutes of Health, the Air Force, the Navy, the National Science Foundation, and the Pentagon. The research produced numerous innovative processes and computer based tools. Many of those projects reached fruition in 1969.

Second, the government recognized the need to share results of that research throughout the country and so, promoted development of a means to provide access to information and to computational resources from any remote location. The result was the ARPANET.

Third, because all of the research was funded by the government, the results resided in the "Public Domain". This aspect of public funding allowed the spawning of thousands of businesses, both small and large, based upon the designs and techniques implemented in the universities, for both computers and communications. All of which have benefited the USA greatly.

THE QUESTIONS (Asked By Gary H. Anthes, Senior Correspondent, Computerworld)

1. What was your role in the creation of the ARPANET and what has been your role in the evolution of the ensuing 'Internet?

For 15 years prior to the inception of the ARPANET I had been implementing systems for process control, graphics display, and the interconnection of all types of computers either directly or over telephone lines. During the 60s I was supporting UCSB on projects to provide classrooms with interactive graphics terminals used for mathematical analysis. That work was funded by ARPA and was the basis for selecting UCSB as one of the first ARPANET sites.

I had designed interfaces for machines like the IBM 360 at UCSB and it was an easy task to produce an attachment for the IMP from BBN when it arrived on campus in 1969. The specification drafted by BBN set forth the specific language by which to talk to the IMP and to remote sites. It was that language that became the first "protocol" for interacting with packetized communications traffic.

Our laboratory produced IMP interfaces and software for many of the later sites, and experimented with remote site job submission and the transfer of graphics data over the network. Research began to take the form of how best to move different types of data to all types of machines and teams met in "working groups" composed of students, staff and researchers from the other universities and from BBN. It was those working groups that made the decisions on how to solve problems and established the standards that became first NCP and then TCP/IP.

In 1974 I formed a company called Associated Computer Consultants (ACC) and worked with government agencies on the implementation of packet networks and attachments. ACC produced network interfaces for UNIVAC, IBM, DEC, Burroughs, CDC and Honeywell machines. Many of these are still in operation and have migrated from ARPANET to Defense Data Network, to MILNET, and to the Internet.

Our present products are in use all over the world in military and commercial network operation. Our bridge/routers, and WAN connection products connect workstations and servers and come in ruggedized versions for battlefield use where connection is to a network, and even the Internet, by satellite means.

2. Will the so-called "Information superhighway" evolve from today's Internet or will it grow from different roots?

We are presently working with customers that are moving data over SONET connections. Such high speeds will be used for the Information Highway. The techniques for moving information derive from those used on the Internet and, in almost every case, these trial networks are each linked back into the slower networks that comprise the Internet. So it is an evolutionary process supplemented by new techniques and higher speeds.

3. Can the Internet continue to scale up indefinitely or will we reach the point where a radical new architecture will be needed?

The Internet has continued to service huge numbers of users because there are "rules of the road" and because the Internet is really composed of myriad ancillary networks. Much of the traffic passes over non-conflicting paths. The recent change in the type of users, some who "flood" the media, could mean that controls need to be added to limit unreasonable use. However, if the bandwidth and the number of paths continue to increase, it might still be able to accommodate everyone.

4. Do you see the Internet community evolving more and more toward commercial use? For what purpose will commercial users use the net?

Our company has used the ARPANET, the DDN and the Internet for communication with customers. Most of them were military or government so that is according to the rules. In recent years every company dealing with computer networks uses the Internet for transfer of messages and for the transfer or "down-load" of computer software. BBN has always updated the IMPs over the network and that is what is done by the rest of us as well.

While building new interfaces for CSC our software is being ported to Sun SPARC stations by Sun Engineering. We supply our source code over the Internet to Sun, and they send the modified code back to us over the Internet.

Computer related commercial use of the Internet is massive but probably not nearly as large as that for E-Mail, Bulletin Board, information access and conversational traffic. These uses are increasing dramatically. Junk mail is coming on-line but hopefully will not overpower the rest of us. Look at your commercial fax machine, every night one receives something unasked for like ads, solicitations, and resumes. So far that has not happened to us on the Internet but it is happening to others.

5. Many would-be commercial users avoid the Internet because of security concerns. Are those concerns well-founded? Are there solutions?

Protection of sensitive information is a great concern when using any network, the Internet is not unique. The reason the Defense Department has hundreds of networks is so that Secret, Top Secret, Confidential, and Clear traffic are not mixed on the same backbone.

ACC has just installed Multi-Level Secure routers to address that problem. Our first customer is the US Government and our second customer is US West. US West finds that it cannot offer networking services to people that operate hospitals because medical records are private and cannot be accessed by unauthorized people. Networks can be penetrated and users may even send information to the wrong place. There are solutions coming, and the DoD expects to eliminate large numbers of separate networks as soon as they are guaranteed protection of information.

6. How should our existing telecommunications infrastructure, including the Internet, evolve to meet the needs of corporate America?

Corporate America is already using the world wide telecommunications infrastructure to its advantage. The services provided by the common carriers are very good today. The Information Superhighway will give us more bandwidth for the movement of information among corporations and the telephone companies and cable companies will bring network access into the home as well.

7. What is the most pressing technical issue facing the Internet over the next two to five years?-

I believe that trying to keep unwanted traffic off of the service is important but there is no clear way as yet to separate it from legitimate use.

I suppose that, in order of importance: protection of resources from external access and destruction; security and privacy of information; methodology to increase bandwidth to accommodate growth; elimination of unwanted traffic or intrusion; and keeping the costs down for legitimate use and access to information sources by all people.

8. What is the most pressing business issue facing the Inter over the next two to five years?

I think the above crosses over into this area.

9. What is the most pressing social or political issue facing the Internet over the next two to five years?

One aspect that might curtail the "magic" of the Internet is if some regulatory group selects the wrong way to get rid of unwanted traffic. The Internet grew because it was an open and available resource, albeit mostly available to the "insiders" until recently. That mode of operation allowed it to flourish. Now, if not carefully done, we could put so much of a damper on the overall service as to make it difficult to use, with the result that access to the "services" will be so compartmented as to be cumbersome to the real user and unavailable to the casual user who could benefit as well.

10. Will the "Information Superhighway" give the U.S. a competitive edge?

Our company has used the Internet, internationally, for years. I would have said yes to this question five years ago but now it is only a matter of time before all traffic from users, no matter where they are, will pass over the Information Superhighway just like it now does for the Internet. Access is everywhere. In 1982 I went to China

and talked with researchers about computer communications of the future. In 1992 I gave a seminar to the Chinese National Coal Corporation and was able to borrow an X.25 switch from a computer store in Beijing to put on a demonstration. Everybody is doing it, and everybody has some kind of access today.

11. Will commercial users, including advertisers, harm the Internet or will they strengthen it?

They could harm it if completely uncontrolled, as stated above.

12. What should be the role of government in the roll-out of the Information Superhighway?

If the government pays for it and helps it grow and makes it available to all users (with some reasonable controls) it will be a great boon and resource. If the Congress refuses to put the necessary dollars into making it right, then it could turn out to be good only for the commercial users.

Given the right funding, the right goals, and the right people running the project (like those from ARPA in the beginning), the government could do the country a great service. The project will be ruined if the contract is given solely to any one of the "prime contractors" because the moneys will be taken, the wrong technology will be used, it will not work well, it will be too expensive, and it will never quite be finished.

One of our present consulting jobs is to make a network work that was built by a major contractor for unmeasurable dollars and in which they used the most expensive products, none of which worked together, to try to build a network they did not understand; and they did it for a fee calculated on the amount of money spent to do the project. A real disaster, and if they had only brought in a real networking company like BBN in the first place they would have had a working network four years ago. We are replacing the expensive gear with commercial products and have part of the network in operation now.

The government is the right one to run the project and to do it using an Industry-University Working Group. The participants in the Group should be paid to coordinate the building of the first legs of the Information Superhighway, and those first installs should not be considered prototypes but be directed at actual use from the day it gets turned on.

The Industry-University Working Group, under government auspices, should be dedicated to getting the job done and should be allowed to run every aspect of the project; specification, choice of equipment, implementation, installation, reporting and demonstration.

ABOUT YOUR NETWORKING SCROLL FROM ACC SYSTEMS

We hope you will enjoy this scroll which contains a number of references to modern networking and protocols. We can say "modern" because connectivity or interconnectivity as achieved today was not always so easy. In the '50s and '60s connections were primarily to a single machine and mostly point-to-point. Moreover, every time two different types of machines required connection a special interface had to be designed.

Designers strove to make the interfaces modular so that each successive unit was easier to implement; but all computer systems were different, designed for different purposes, with variable numbers of bits per word or character.

Packet networking and the concept of a common language for communications to allow dissimilar systems to communicate, produced a fundamental change. A group of computers available 24 hours a day to move information reliably from source to destination, with redundant connection paths, was a revolutionary idea.

In the late '60s the Advanced Research Projects Agency (ARPA) provided funding for the development of such a network; and, Bolt Beranek and Newman (BBN) won the contract to implement that first packet network, the ARPANET.

The finger tips at the left of the scroll depict the ARPANET sites connected in late 1969. Those sites were precursors of others to come, with the new network destined to link the varied resources resulting from more than 20 years of research in basic computer science. The contracts and grants that allowed such research came from decades of government funding. Funds came from ARPA, the National Science Foundation, the Office of Naval Research, Rome Air Development Center, National Institutes of Health, and other departments and agencies of the government.

With those funds, computer science in the USA took great strides; producing much of what is taken for granted today. The first four sites on the ARPANET embodied the work of inventive and creative people, like Glen Culler (UCSB) using interactive graphics to solve mathematical problems, Dave Evans and Ivan Sutherland (UTAH) with graphics and image processing, and Doug Engelbart (SRI), who invented the means for computers to augment human ability in the creation and manipulation of textual material (Doug invented the mouse, a copy of the first one is shown in the drawing).

The other ARPANET site, UCLA, was involved in network measurement and modelling under the direction of Leonard Kleinrock. UCLA was also home to the Network Working Group, chaired by Stephen Crocker who led the development of the first host-host protocols.

If you look carefully behind the Vitruvian Figure you will find a map of the ARPANET as it was during 1971. The rest of the illustration attempts to give credit to many of the networking pioneers during those early years. Those from ARPA included Bob Taylor, J.C.R. Licklider, Larry Roberts, and Barry Wessler; those from BBN included Frank Heart and Bob Kahn among others as shown.

We have tried to memorialize as many of the others involved with that rapid implementation of new ideas and techniques as we could remember; but there are, no doubt, some apologies due to those who were missed.

Roland F. Bryan

Internet (World Wide Web) Attachment

A Turn-Key Approach From ACC SYSTEMS

The Internet Storefront

The debate about the commercial potential of the *World Wide Web* has cooled in one regard: bears and bulls alike are increasing their predictions. From a conservative $3 billion to a wild $10 billion, estimates of short term growth of commerce on the Internet are attractive enough to draw thousands of new businesses to the play the role of "Internet Storefront".

Although conceptually *young*, there exists no more cost-effective means for moving information than the Internet. Many businesses are successfully using the World Wide Web for either of two purposes:

- To provide for public or private information access;
- To directly market and sell products to the growing Internet community.

Opportunity Abounds (Two Commonplace Examples)

Individual Inc.: This fast growing company has been incredibly successful as an electronic 'clipping service' using the network to distribute articles and analyses compiled from various trade related magazines, journals and news releases. With thousands of subscribers world-wide, *Individual Inc.* is able to deliver a product to their customers at a fraction of the direct costs of traditional publishing and distribution; and with almost no operating overhead. Their product is available to customers instantly, 24 hours per day.

Cybermalls Inc.: After only several years in business this company's greatest challenge is to keep up with the demand its Internet marketing program has created. Originally selling only computer components and systems via the "Web", Cybermalls is quickly branching out into general merchandising, now representing 600 manufacturers and distributors with over 2,000 products for sale. Running as a retail operation, Cybermalls takes a mark-up on all products sold. With the remarkable technology of the Internet, Cybermalls answers an average of 250,000 product inquiries from an estimated 30,000 Web users *per day!* Using new technology, this fast moving business is able to guarantee credit card security to its buyers.

Setting Up Shop

A business wanting to provide information or sell product over the Internet enters into a complex technical program. The basic elements include:

- Contracting with an Internet Access Provider who administers the Internet "feed";
- Leasing a high-speed phone line to connect to the Internet Access Provider;
- Purchasing, configuring, installing and maintaining communications gear including routers, modems, cabling and test equipment;
- Purchasing, configuring, installing and maintaining "Server" hardware and software (computer system, storage and facilities) ;
- Contracting with, or hiring, a software consultant to program each page to be presented on the Web, and to maintain and modify each page when changes are required.

Once these elements are assembled and operational, a strategic marketing campaign designed to attract network traffic to the business site is mounted. The components of a successful Internet marketing campaign are essentially unknown in the traditional marketing community and may include:

- Crafting a WWW presentation that will encourage access by consumers;
- Negotiating 'reciprocal' links with complimentary WWW sites;
- Posting appropriate messages to carefully targeted forums and newsgroups;
- Positioning company/product descriptions and other 'meta' information for the most efficient listing in Network Directories and What's New listings.
- Targeting appropriate Internet resources (editors, purchasing agents, manufacturing managers, IF managers) for Email access.
- Establishing secondary or 'mirrored' sites.
- Using traditional marketing (FAX, telemarketing, publishing) to promote the site.

Who Is Doing It?

A quick tour of the World Wide Web leaves a common impression: The breadth of information, products, and services available is staggering. From a mom & pop fly-fishing

program can be as successful for the small business owner as for the corporation. A poll of corporate names on the net shows that the Fortune 1000 believes a successful marketing strategy incorporates presence on the Web.

The end result can be seen in decisions by major computer manufactures to develop servers specifically for the Internet. The configuration of these machines and the software bundled with them targets small to mid-size businesses and offers expandability for growth. Communications equipment vendors are now seeing more sales to less technically-oriented customers.

But, for the layman, the task of designing a network, buying the hardware, programming the computer, and finally getting it all to work is undoubtedly the largest obstacle to setting up shop on the Internet. Once all the pieces are in place, on-going operational costs, in comparison to other advertising media, are negligible. Getting up and running, on the other hand, is nearly impossible for the do-it-yourselfer and quite expensive for the contractor, primarily due to engineering and consulting fees (the uneasy reliance on outside help) that are necessary to assure the proper networked business infrastructure.

The WANSERVER™ From ACC SYSTEMS Addresses The Niche

Getting a UNIX workstation to run properly for a specific task is no mean feat, but usually results in the highest performance, most cost-effective computing solution available. This holds true for the Internet Storefront market. The vast majority of successful Web sites, especially commercial Web sites, are UNIX based platforms that provide unequaled performance and networking flexibility. Because Internet Server software is adaptable in terms of applications, operations, and communications, a working model can be superimposed, like a recipe, on a would-be Internet Business.

Today, many consulting groups sell engineering expertise, capitalizing on business' reliance on experts. This pool of talent is doing quite well, with estimates of Internet access installations happening at the rate of 10,000 per month, worldwide. Choosing the alternative, the WANSERVER™ product from ACC SYSTEMS, provides a "cookie-cutter" approach, integrating both communications hardware and software into a high performance UNIX platform particularly designed and suited for Internet Business.

The WANSERVER™ From ACC SYSTEMS Eliminates The Need To Do It Yourself

See Next Page For The "Internet Storefront Shopping List"

Internet Storefront Shopping List

Typically, a business wanting to provide information or sell product over the Internet must administer a complex technical program. The basic elements include:

Telecommunications
- Installation will cost between ~$300 and $1,000 depending on line type;
- Leased lines will cost between ~$200 and $1,500/mo. depending upon volume;
- Test equipment to monitor and maintain line quality will cost ~$2,000 or technical support will cost ~$150/mo.

Internet Provider
- Installation costs for the Internet Access Provider who administers the actual feed from the Internet average ~$1,500;
- Monthly subscriptions cost from ~$300/mo. to $3,000/mo. depending upon volume.

Network Consultant
- Design network, specify equipment, software ~8 hours @ $100/hr. or ~$800.

Information Systems Consultant
- Specify Host platform, OS, server, applications software.

Communications Equipment: Equipment Costs
- DSU/CSU equipment will cost ~$400 - $3,000 depending upon line;
- Coms Front End (WAN-Host attachment) will cost ~$2,000 to $20,000 depending on line speed;
- Cabling and Transceivers will cost ~$200 - $2,000 depending on Host configuration;
- Maintenance ~5%-~10%/yr. of total equipment costs.

Communications Engineer: Installation/Set Up/Test
- DSU/CSU ~4 hours @ $75/hr. or ~$300;
- Front End ~20 hours @ $75/hr. or ~$1,500;
- Local cabling ~8 hours @ $50/hr. or ~$400.

Server (Host) Equipment (minimal), Software
- CPU, Monitor, Keyboard, Storage, Back-up ~$10,000;
- OS Software ~$1,500;
- Server Software ~$500 - $5,000 depending on security req.;
- Coms Software ~$500 - $1,000.

Systems Engineer: Server Installation Configuration, Test
- OS configuration, test ~8 hours @ $100/hr. or ~$800;
- Server/Coms Software configuration, test ~ 16 hours @ $100/hr. or ~$1,600;
- Hardware Installation, test ~2 hours @ $100/hr. or ~$200.

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